"JOURNAL OF THE CONSTRUCTORS CLUB"

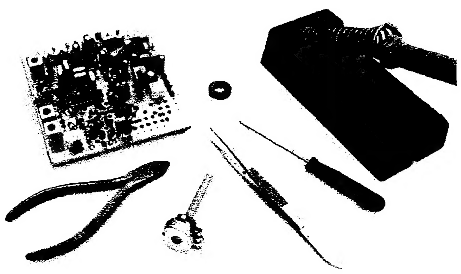
Hot Iron

Winter 2005
Issue 50

Contents

The Walford Electronics website is also at www.walfordelectronics.co.uk

Editorial



Re-reading the last Hot Iron, I see that my mind was in neutral due to the heat; this time is the opposite extreme! Its been below freezing for several days at night and often not thawed out fully out of the sun by day. Blizzards were forecast for last night but it only started snowing just as I left the house this morning to feed the cattle and sheep! Two hours later and the sun is out with a lovely bright day.

Over the years, we have been plagued by 50 Hz mains failures for all sorts of reasons ranging from lightening strikes to collisions by swans on the overhead 11 kV supply lines, so with the warnings about supply shortages, I have invested in standby alternatives. Two days ago, the local 11 kV transformer burnt out a winding so I felt rather pleased when I was able to change to the back up to keep the gas powered/electrically controlled AGA cooker going! Being an old farmhouse and difficult to lag properly, it looses heat pretty quickly so an alternative is rather important. See later for details - but I have to warn that this was not cheap and was partly an interesting experiment! Tim Walford

Kit Developments

Last time I mentioned the new 'K' family! The Kilve RX is available now and will be featured in the Jan 2006 PW, with articles on the DSB phone TX, and how to link them up for transceiver operation later in the year. I have begun thinking about the replacement for the Bristol, which I had to withdraw due to the relay manufacturer ceasing production of the right model. The current idea is for a base CW and SSB phone 5W rig; which would do any single band to 20m with a direct injecting VFO. Then an 'extras' unit could be added to provide two more bands and a crystal mixing scheme for the LO so that it would become an any three band rig up to 10m, with AGC and other accessories like a variable bandwidth CW filter.

In the meanwhile, I have replaced the signal source kit with a new and more capable harmonic marker kit, re-introduced the two tone audio oscillator (both £15 + £2 P and P), laid out a relay selected twin RF bandpass filter unit, laid out a new RF signal generator/twin band VFO, and started on a small static inverter unit. That lot all needs writing up, testing etc., as well as an update to the website!! Looks like a busy run up to Christmas. **Merry Christmas** to you all and may Santa do everything that he is rumoured to do! Tim G3PCJ

Hot Iron is a quarterly subscription newsletter for members of the Construction Club. Membership costs £7 per year with the first issue for each year appearing in September. Those people joining later in the year will be sent the earlier issues for that year. Membership is open to all and articles or questions or comments or notes about any aspect of electronics—principally on amateur radio related topics– is very welcome. Notes on member's experience building their own gear, from kits or otherwise is most interesting to other constructors. To keep it interesting, your thoughts and ideas are required please! For membership, I only need your name and address and subscription. Send it or any other suggestions to Tim Walford, Walford Electronics, Upton Bridge Farm, Long Sutton, Langport, Somerset TA10 9NJ © G3PCJ

The Top Loop by Richard Booth G0TTL

For some time now I've been using "magnetic" loop antennas with excellent results on the HF bands. Considering the size of the driven element and the fact that they work well at only a few meters above the ground I've found them to be very useful. Until recently though I've not tried anything on 160M and having an urge to try something different I decided to have a go at building this loop. Conventional magnetic loops use a single turn as the radiator, however at this frequency you would need to make the loop at least 3 meters in diameter, and use a large 1000pF plus tuning capacitor to make it efficient. As you can imagine mechanically things start to get complicated with something of this size and keeping the whole structure upright and in shape would be a challenge. This loop differs in that it is made from 4 complete turns in a coil wound at diameter of just 170cm. It covers the whole 160M band with a very high Q factor which means you need to adjust the variable capacitor to resonance every time you change operating frequency - the bonus here though is that the antenna acts as a band pass filter and gives a tremendous reduction in out of band noise. It is also somewhat directional which gives a useful null that's handy for cutting out local interference sources - a common problem on 160M.

Construction is fairly straightforward. Good quality solder joints are required as the goal is to keep the resistance of the loop as low as possible. You'll need a decent quality tuning capacitor which will go up to 125pF. A standard air spaced broadcast type is OK for power levels up to 10W - above this you need to use a higher voltage component, for instance at 50W the RF voltage across the plates is about 2000V. A cheap solution is to dismantle a 500pF capacitor from an old valve radio and reassemble it with the plates well spaced out. This will bring the total capacitance down, and put the working voltage up. I can help with this!

The main loop is made from "thick" type coaxial cable. If you can get the semi rigid kind that's even better as it will be easier to keep the loop uniform. You need a single length 21.5 meters long to wind it. First of all strip an inch off either end and solder the inner and outer conductors together to make one single conductor. You'll need to make some kind of cross shaped timber or fibre glass frame to support the loop. Each arm of the frame should have a right angled front facing piece at the outer edge to support the separate turns of the coil. You can use a metallic pole for the vertical support but it is essential that this is truly vertical and passes through the centre point of the loop. Wind four turns onto your frame, starting at the bottom end next to one side of the tuning capacitor. Remember to leave enough to make the connection to the capacitor! Fix the cable at each leg, leave a space between each turn equal to the thickness of coax used. Try to keep the loop as circular as possible, but don't worry if it droops a little between the supports. Solder each free end to either side of the tuning capacitor.

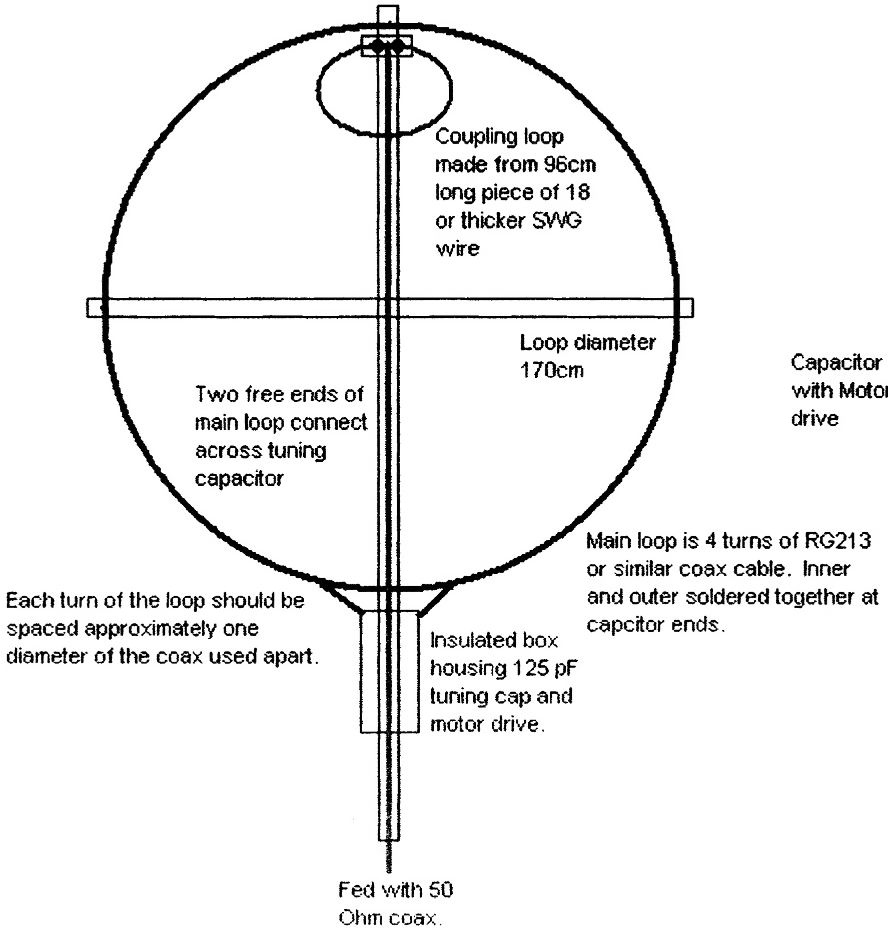
The tuning capacitor really needs to be motorised. I used one of the gearbox reduction types available from Maplin for my prototype and connected through a further 6:1 Jackson type reduction drive to the capacitor. This works reasonably well but does generate a fair bit of interference when making adjustments. Some people might find that useful - when the noise is loudest you should in theory be tuned to resonance! Mount everything in a weatherproof box. A cheapo lunchbox from Tesco and a few blobs of silicone sealant does the trick.

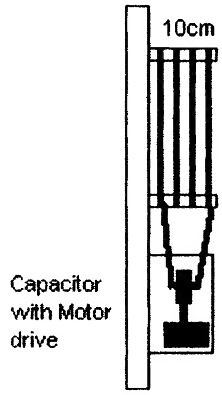
The coupling loop is made from 16 or thicker SWG wire. I used stripped down 30A twin and earth ring main cable. Leave the insulation on. For this you need a piece 96cm long. Bend this into a loop. Each free end connects to either side of the feeder coax. I suggest mounting the two ends of the loop into a plastic box, fit a SO239 socket in the base and then solder the two free ends to the socket. If you drill some holes for a U bolt in the back of the box you can clamp it in place at the top of the main loop (see diagram). The feeder should run vertically down the centre support and away from the antenna. When testing the antenna you may need to slightly alter the shape or location of the coupling loop to achieve the best SWR. I've found that a squashed almost oval shaped coupling often gives the best results. My prototype loop has an SWR of 1:1.4 and a useable bandwidth of about 4KHz before retuning is required. Just enough for a QSO!

(Richard has done such an excellent diagram that I have to repeat it on the next page untouched by my pen! Tim)

The Top Loop continued

If you do have a go at building the Top Loop I'd be happy to hear from you. I'm QTHR or you can email me at richard@pasttimesradio.co.uk Richard Booth, G0TTL





Antenna Snippets

As a comment, Richard's design above is very similar to my 'heating radiator' loop! That uses 15 mm malleable copper pipe instead of heavy gauge coax, formed into a multi-turn square of side about 0.5 metre. I have always felt that input coupling through a small loop would be a bit less efficient that direct connection of the driving rig so I used a gamma match approach – in effect a tap a small part round the loop from an 'earthy' point. This can have the disadvantage of unbalancing the loop and might also degrade the Q, which in Richards case is very high indeed to achieve such a small bandwidth! I also found out the hard way that using one turn of rubber covered multi-core mains cable (with the cores connected into a multi-turn loop) is no good whatever! It has far too much self capacity between cores so that hardly any external tuning capacity is needed! It was also very lossy! Forget that approach!!

Last time I was unsure who had designed the E P Antenna that Dave Buddery had sent in. I now know that it was Dave himself! Well done.

I also see a correspondence item in Radcom about Windom antennas; there had been an article about what was supposed to be a Windom but the authors opinion was otherwise. Its is really surprising how often new ideas for antennas turn out to have been invented in about 1920!

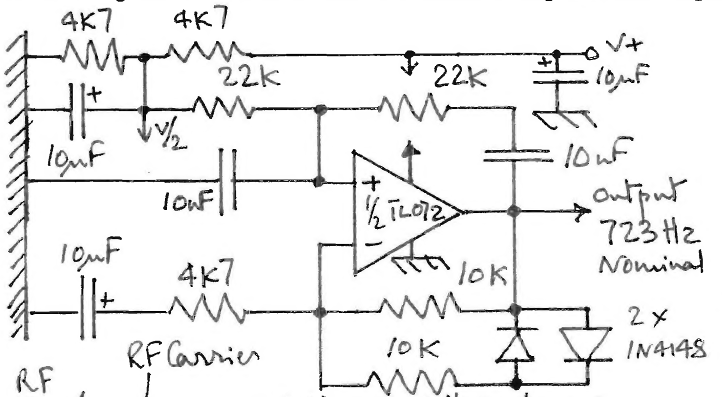
Its hardly an antenna snippet, but I must also report that my good friend and antenna advisor, Eric Godfrey G3GC, has been in hospital for some weeks following a fall. I am pleased to report that he is getting better and was even talking recently about laptops for writing articles in Hot Iron etc!! We all wish you a speedy recovery Eric. Tim G3PCJ

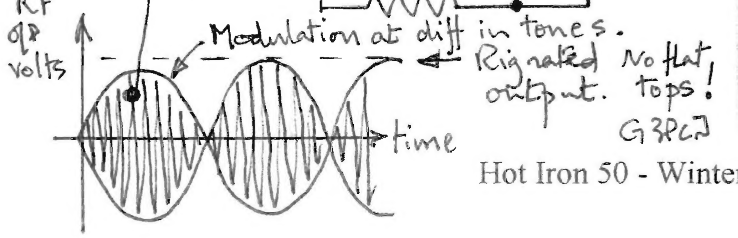
Two Tone Oscillators and setting up a phone rig

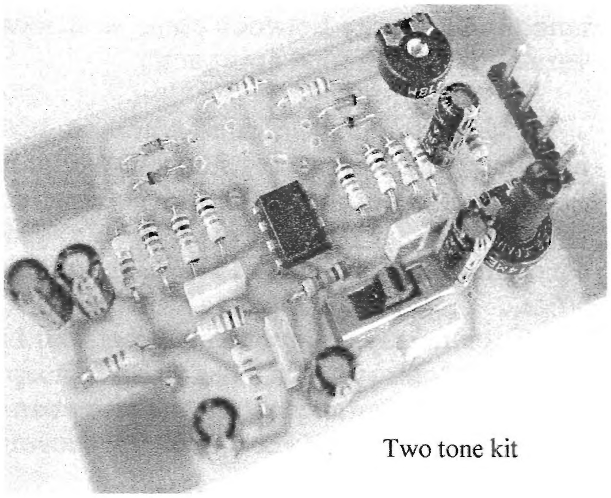
Setting up a phone SSB (or DSB) transmitter should ideally be done with an audio signal source that is based on two equal amplitude audio tones. This sort of transmitter has to have linear RF stages so that the amplitude modulation inherent in the modulation process is maintained all through the transmitter. This is not required when ordinary amplitude modulation is applied to the final stage of a CW transmitter. The SSB (or DSB) transmitter stages should be adjusted so that none of them are limiting on speech peaks. If a stage does 'limit' in either direction, unwanted extra harmonics of the audio are produced which appear as rubbish modulation for a few KHz on both sides of the nominal carrier frequency. Limiting of a particular stage can be due to insufficient signal handling ability in either direction; in a negative sense the output voltage can get too close to 0 volts or to the 'hard on' device output voltage - an effect sometimes known as 'bottoming'. In a positive sense, there maybe insufficient voltage excursion range between the normal device output and the supply rail. When the load or DC feed path is inductive, the signal excursion can exceed the supply voltage so the causes are not always obvious! However the appearance on a scope of this sort of poor signal, is always a flat top and or bottom of the signal at its maximum excursions. Using a modulating signal consisting of two individual tones makes it much easier to observe these defects.

Each of the tones in a Two Tone source should be within the normal audio passband and not harmonically related. The signal from each tone should be sinusoidal and they are added together before input at low level to the rig under test. Generating sinusoidal tones is not as easy as it might seem - especially if a wide adjustable frequency range is needed - thankfully not needed in this application! Standard value capacitors and resistors can be used for nominal frequencies of 723 Hz and near 1590 Hz, with a circuit using a frequency selective feedback network based on the Wien Bridge. The easiest way to control the amplitude of each audio tone is with silicon diodes in the op-amp negative input feedback network. The sketch below shows the circuit for the 723 Hz oscillator. The Two Tone kit (photo - £15 + £2) has two oscillators with a control switch so that each maybe used on its own as a signal source. They are added and output at low level for the rig's mike input.

The transmitter is connected to a dummy load with RF output being monitored on a scope. When correctly adjusted, the picture should look like that below, where the RF envelope is amplitude modulated by a sinewave whose frequency is actually the difference in frequency of the two tones. Note this is NOT the ordinary appearance for amplitude modulation - with no audio input the SSB RF output is also zero and there is a sharp cross-over at 0 volts of the modulating envelope. The procedure is to first make certain that the later stages are not causing a flat top or bottom of the output envelope, due to problems in any stage after the one being adjusted. This is generally done by reducing the RF output to a fraction of its rated figure. The gain or drive level in the earlier stages is increased until a flat top/bottom appears and then eased back a little. This is repeated for the next gain adjustment control(s) until flat topping is just avoided in the output stage. This sounds complicated but is actually quite easy when you have tried it once! The peaks the envelope now should correspond to the rig's rated output. If either tone is now turned off, the plain carrier level due to the remaining steady tone should be half the rig's rated output. It is possible to get near the optimum settings with a single tone, but using two makes it much easier. It will be necessary to adjust the mike gain control for the real mike to produce equivalent levels to the 2 Tone source. Tim







Two tone kit

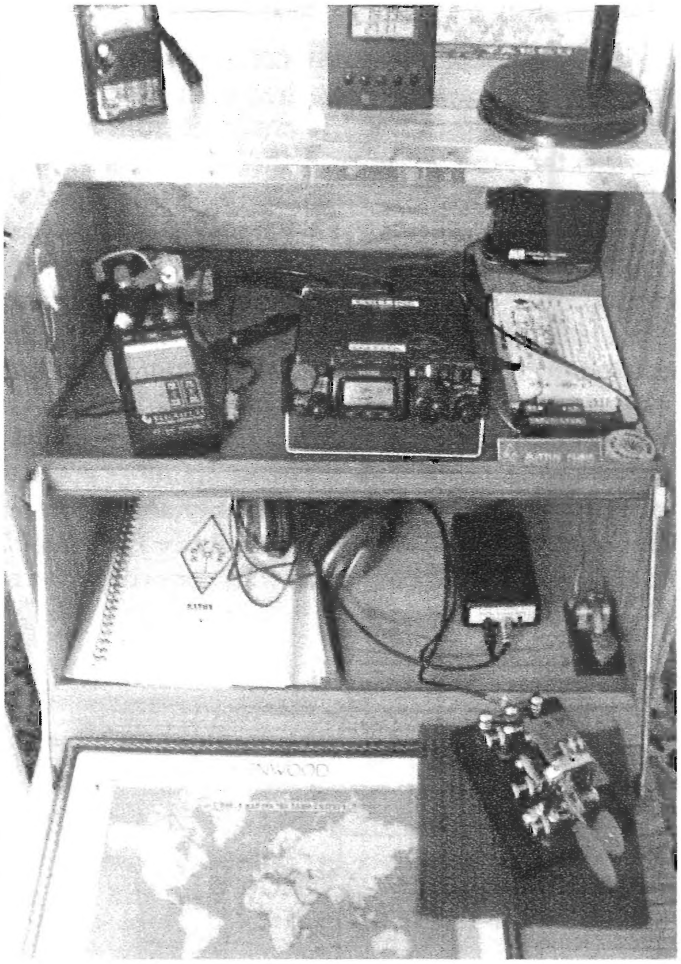
Retirement to Alderney by Chris Rees GU3TUX

Since packing up business last year and our subsequent move to this diminutive island in May, I've had a whole new series of problems to overcome in pursuing my interest in amateur radio. Not least amongst these problems has been a lack of interest! I guess that having had radio as a business has, for me, rather taken the shine off it as a hobby and the progress of technology has taken much of the excitement away as global communication is now cheaply available to the masses. I'm still interested in communication but, like the youngsters, using today's technology in the form of the Internet and its mobile interfaces.

I've redefined amateur radio as a 'heritage activity' – a means of keeping old skills alive. Indeed, I'm convinced that this is the only way to ensure that the hobby survives in the long term, rather like the groups in Oz and the USA who keep the land line telegraph accessible. This new definition means that I shall really only obtain any mileage from the hobby by using homebrew equipment (and QRP CW to boot!). I've brought down here crates of components, kits, aerial materials and just about everything I shall ever need but, for the time being, my shack is limited to a small bureau-like piece of furniture in the corner of the bedroom. We've moved to a small bungalow which has space and potential for expansion, so I'm hoping for a custom built shack later.

Due to the strength of the winds, Alderney is not well endowed with tall trees and I'm deprived of any natural aerial supports. Our corner plot is exposed to the public gaze so the strict planning regulations mean it is unlikely I'd obtain permission for masts, although I might get away with a flagpole and an inverted V disguised as guy wires. At the moment I have dipoles for 20 and 40m in the loft on a single coaxial feeder which I strap at the base end to load on the other bands.

The rig pictured is an FT817 supported by an Elecraft T1 auto ATU which I built within the confines of the bureau flap. My keyer is also a kit – the TiCK4 which offers a couple of memories and my preferred mode A keying. The other accessory is a simple RX audio filter, adapted from a design by G4BJM in 'Radcom'. This has a LPF to cut down the hiss from the 817's AF stage and a gentle peak for CW operation. I must mention the loudspeaker – it is a MFJ281. Not only is it incredibly sensitive but it also has a noticeable response peak at around 700 Hz. It must represent very good value for money, especially for the CW operator.



I don't have any VHF/UHF aerials in the loft – yet. Past experience suggests that quads are relatively unaffected by adjacent objects and a likely candidate for another home-brewing exercise. Indoor aerials have a number of advantages; they're discreet, they don't have to be wind and rain proofed and - usually - they're easy to install and adjust. Radio lore says that the roof tiles account for a loss of 6 dB versus an outdoor slung equivalent, but this can be a fair price to pay. If you're thinking of trying a nest of dipoles on common feeder, start by pruning the highest frequency aerial first and the LF one last.

I do monitor the VHF/UHF channels on a QRP handheld, the little Yaesu VX1R. The local airport and harbour frequencies provide no little entertainment, especially in dirty weather. The island has relatively sophisticated communications for its size. We talk to the outside world via microwave link to Guernsey. This includes 1 Mb broadband access for private subscribers. A communication profile of Alderney could be the subject for a future article.

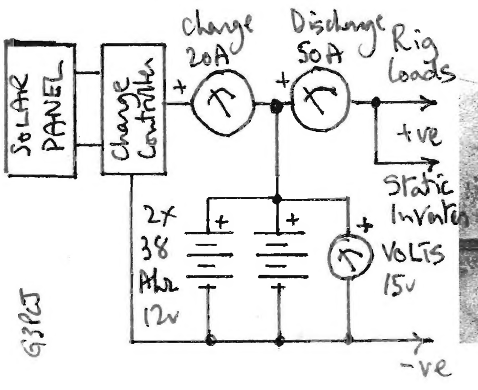
Finally, with our locally generated electricity currently costing 17p per kWh unit, QRP is a definite advantage and I'm planning to use solar power for the station in the New Year.

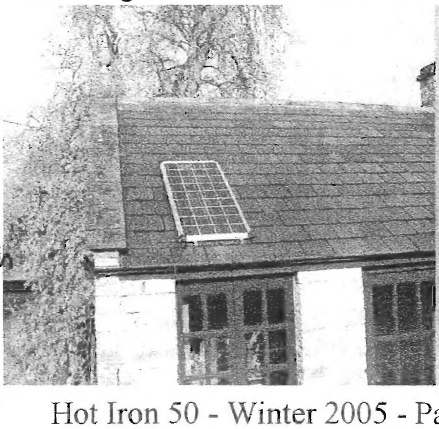
Standby Supplies

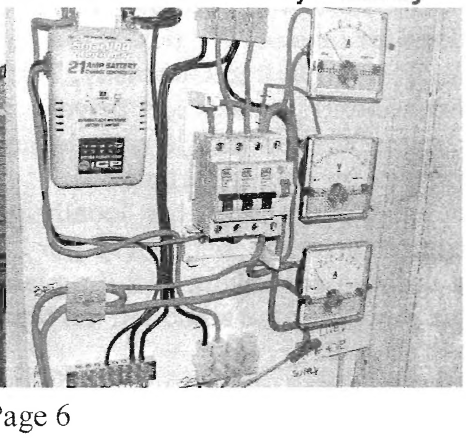
There are several important questions that have to be answered before one can design an alternative to the normal 50 Hz mains. Perhaps the first is to decide what loads one needs to cater for, measured in Watts; bearing in mind that not all need be supplied at the same time. Its also important to distinguish between running consumption and start up consumption. (In the case of many electric motor powered items such as fridges and freezers, the starting load maybe many times the running load and also highly inductive so these are best avoided if possible. Interestingly, central heating pumps do not seem to be a problem - perhaps because they are not genuine induction motors.) My primary concern was to keep a gas powered cooker supplied for its fan and electrically controlled gas valve, with a secondary objective of running the central heating - again gas powered but with electric controls and three pumps. The load of the cooker is about 25W, the central heating controls and boiler about the same and each of the three pumps about 75W. So I was considering a normal load of around 100W rising to perhaps 300W if all were on at the same time.

There is no need for these to have un-interruptible 50 Hz provided by a continuously running inverter. (Computers are very different as they should be turned off in an orderly manner.) The cooling time constant of all these heating loads are of the order of an hour so, giving plenty of time to reconnect to the standby source using ordinary 13A plugs and sockets! I reckoned that having to power all for more than a few hours was unlikely but I might conceivably need 24 hours at the lower 100W level. I wanted 12v lead acid batteries for storage so that I could also run the electronics bench from them. The inverter load of 100W would imply a 12v DC of around 10A allowing for small inverter losses. This suggest that batteries with 240 Amp-hr capability should be provided. That's a lot of battery, especially as the deep cyclic discharge type are advised for this application (not car or tractor types); they are comparatively expensive so I opted for two 38 Ahr ones connected in parallel. I chose a 600 W 12v DC to 240v 50 Hz inverter as there might be uses for it around the farm to power hand tools etc. (As an aside, most commercial static inverters now produce a modified sinewave output that is neither truly sinusoidal nor a square wave - these have a lower harmonic output and are suitable for most domestic loads. They work by producing high frequency AC (to reduce the transformer size) which is then rectified to produce plus/minus 350v DC, which is then chopped for 240v 50 Hz output.) When put to the test recently due to a burnt out local 11 kV substation transformer, the inverter input current was 5A when powering only the cooking stove - fine for at least 16 hours. Beyond that, I can use a 5 kW diesel engine powered generator!

The battery bank is charged from a barn mounted solar panel. This was more convenient (lower) than the house roof and also pointed in the optimum direction but was distant so relatively heavy cables were prudent to minimise IR losses. Again cost dictated the panel size! A nominal 100W panel is about 2 ft by 6 ft and it attempts to charge even in the weak morning frosty sunlight. At midday in bright winter sun it is producing 4 Amps - half its nominal rated output. Depending on cloud cover etc, it will take some days to recharge the batteries when totally discharged but for powering the electronics bench, it is more than enough. A charge controller is used to prevent overcharging. Because this installation was 'experimental' I over egged the panel meters and added MCB trips to protect against the lengthy cables being damaged. The outline circuit is shown below - plus pic! Don't ask what it all cost! The trickiest practical bit is installing the solar panel on a slated or tiled roof. The supplied stainless steel brackets were an unsuitable shape, so flattened 22 mm copper tube was used, suitably solder tinned to avoid corrosion where it touches the aluminium panel frame - as advised by Andy Howgate. The brackets need securing to the roofing battens so they protrude through the roof covering. The metal work was then covered in Waxoyl. G3PCJ







Theory - CR Coupling circuits

These sums are probably the most often used ones that an analogue circuit designer will require. They relate the size of input and output coupling components to the bandwidth of signals that they will pass.

The top circuit is said to be a high pass coupling network because it will not pass DC and yet, the higher the frequency, the less the attenuation there will be. In between those extremes, the response changes markedly when the reactance of the capacitor is near the value of the resistance. The capacitor might be the input coupling capacitor of an amplifier (to prevent the external circuits altering the device bias conditions), and the resistor might be an actual resistor or, more likely, the parallel combination of the bias resistors and device input impedance. Consider the response for sinusoidal input signals. The C and R form an attenuator, and making the simplifying assumption that the driving device has a negligibly low output impedance and also that the following circuit (amplifier or whatever) has a very high impedance, it is easy to work out the output voltage in terms of the impedance Z of the capacitor:-

$$V_{OUT} = V_{IN} \times \frac{R}{R+Z}$$

From an earlier note on capacitive reactance, you will recall that:-

$$Z = X_C = \frac{1}{2\pi f C}$$

Substituting this into first formula gives the output level in terms of frequency:-

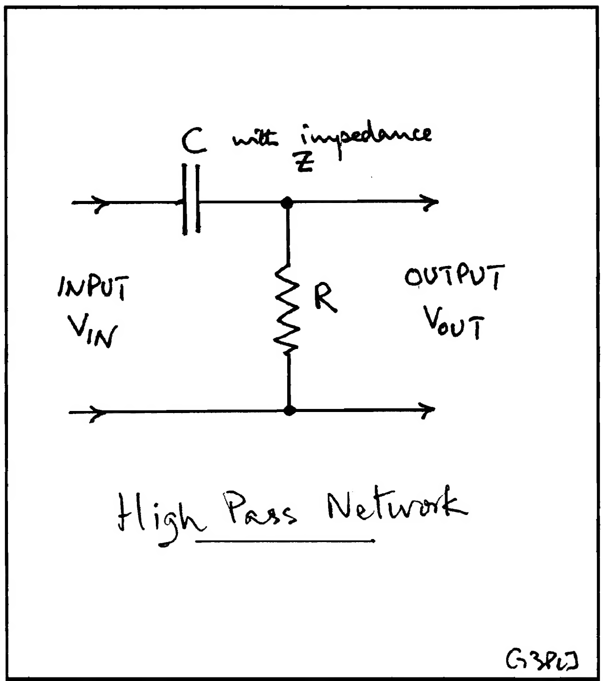
$$V_{OUT} = V_{IN} \times \frac{2\pi f C R}{1 + 2\pi f C R}$$

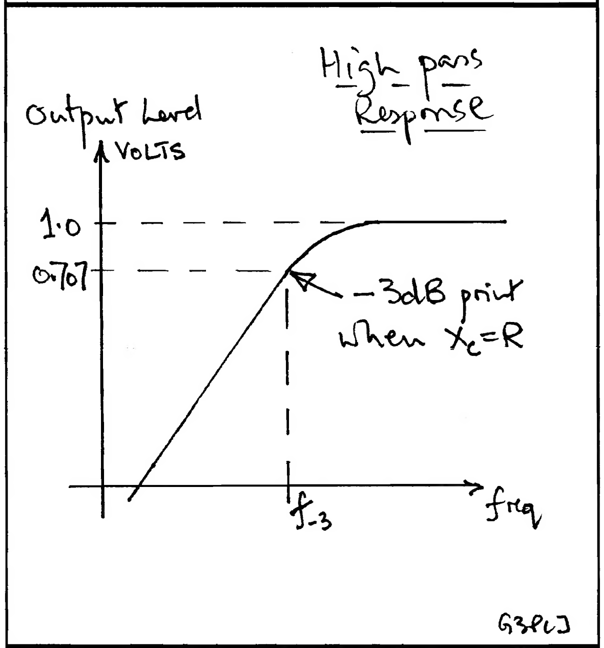
From this it is easy to show the output level is down to 0.707 of the input when the capacitor's reactance is equal numerically to the resistance. This corresponds to the output being 3 dB down (voltage - not power) compared to the input and is the point which is commonly taken as 'the bandwidth' - in this case being the lower limit since it is a high pass network. One can easily turn this around to determine the capacitor size needed to ensure that all signals above a given frequency are passed with less than 3 dB of attenuation:-

$$C > \frac{1}{2\pi f R}$$

C in Farads
f in Hz
R in Ohms

The same formula(s) can be used to determine the size of the required an output coupling capacitor in terms of the lowest frequency to be passed and load of the next stage. Very useful stuff! Tim G3PCJ





$$C > \frac{1}{2\pi f R}$$

with C in Farads
f in Hz
R in Ohms

can be changed to:-

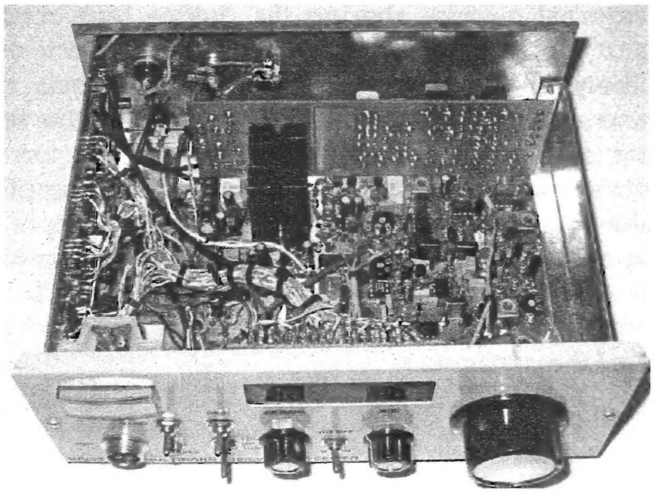
$$C > \frac{1}{2\pi F \Omega}$$

with
C in µF
F in MHz
Ω in Ohms

G3PCJ

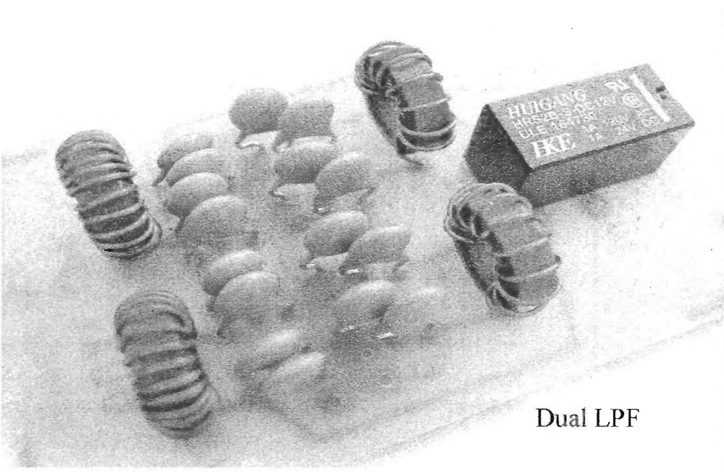
Boxed Bristol

Following my tradition of building things just as they go out of fashion I recently completed my take on the Bristol project. I think the main board layout is a work of art. (What about that cable-form then?! Tim) The completed rig has now become my main HF transceiver and I'm very happy with the end result. Just a few modifications were made to the original specification; I replaced the tuning pots with a single 10 turn type and changed the switched filter wires with screened leads. The 5 digit counter uses larger 0.56" displays. I found that add/subtract connection between the counter board and main PCB also needed to be screened due to interference from it on 10 meters. This most likely though is due to my choice of vertical position for the counter PCB. The case used is supplied by CPC. They sell a range of nice looking dark grey/blue powder coated steel cases with plain aluminium front panels and ventilation slots for between £5 and £11 depending on the size of the case. This is the largest version which is 225 x 175 x 89 mm. CPC code EN81242. The front panel after drilling and several hours of filing to make the slots clean was then sprayed with white primer, and a few hours later with the top coat of car aerosol beige. The labels are laser printed onto acetate and stuck in place with a pritstick type of adhesive. This dries transparent and allows you to move the label around a bit before the glue sets. Any excess can be wiped off with a damp rag with-out spoiling the paint work. The display filter is made from red lighting acetate sheet, to stiffen this up I glue the acetate to a piece cut from the front of a CD jewel case. Hope to hear you sometime on HF! Richard Booth, G0TTL

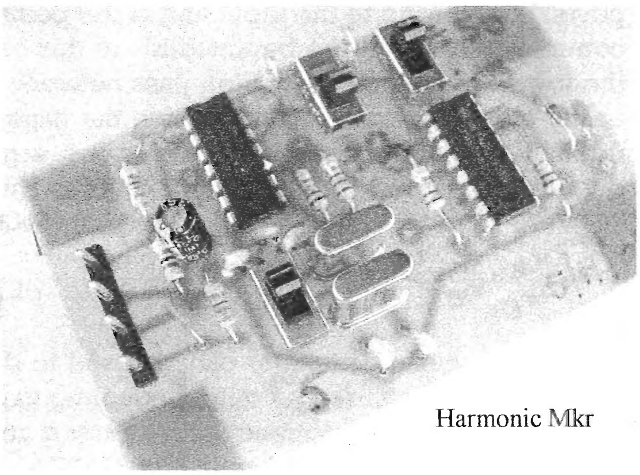


The Somerset Supper and Yeovil QRP Convention

I am planning the second supper to be held on April 8th 2006 in Sherborne for locals and those staying overnight. This is the evening before the Yeovil QRP Convention scheduled for April 9th in the Digby Hall. The convention will have the usual array of interesting talks, trade stands, bring and buy stalls etc., so is well worth while coming - why not make it a weekend! As before there will be a small display of items from each diner's home built radio equipment! Your entry must be different from last years ticket! (Please also bring a QSL card or label.) This will qualify you for a *free* place at the supper table! The competition will this year be judged by Steve Hartley, the well known author of many amateur radio books who writes the Newcomers column for Radcom. He will decide how to judge it and his decision is final! You buy your own drinks. I do plan to a take a photo or two for publicity purposes but this will not intrude into this *social* event where all (including XYLs) will be very welcome. A minimum of formality! Places by advance booking **only** by Mar 28th so please get in touch soonest via walfor@globalnet.co.uk letting me know names. Places are limited - first booked secures their place! Hope to see it and you! Tim G3PCJ



Dual LPF



Harmonic Mkr

 GU3TUX owns AY599!